Aus bipolar wird tripolar: Polarisierung bei Parlamentsabstimmungen

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Swiss Parliament NOMINATE

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Documentation
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Abstract

Estimating ideological positions from voting behavior in the lower chamber of the Swiss Parliament, the "Nationalrat", from 1996 to 2018. Data 2003-2018 from gfzb.ch based on roll calls from parlament.ch, provided by anneepolitique.suisse; data 1996-2003 from parlament.ch, provided by Dani Schwarz. Documentation to a book chapter published as ...

1 Setup

```
knitr::opts_chunk$set(include=TRUE, echo=TRUE,
                      warning=FALSE, error=TRUE, message=FALSE,
                      fig.align="center", dpi=300,
                      dev='png')

rm(list = ls())
setwd("~/Git/papers/paper_konkordanz/docu")
```

```
# Load packages
if (!require("pacman", quietly=T)) install.packages("pacman")
pacman::p_load('tidyverse','magrittr','lubridate','broom','pscl',
               'wnominate','ggridges','forcats','ggrepel')
```

2 The data

2.1 1996 - 2003

```
# Load data provided by Dani Schwarz
load('data/nr-votes.ws96.hs03.RData')

chnom <- nr_votes_ws1996_hs2003 %>%
```

```
  mutate(legis = paste0(str_sub(vote_id, 1, 2)),
         vote = paste0(legis, str_sub(vote_id, start = -4)),
         date = ymd_hms(date),
         name = paste(lastname, firstname, sep = ' '),
         name = iconv(name, 'latin1', 'UTF-8'),
         name = str_replace_all(name, c("Ã¤" = "ä", "Ã¼" = "ü", "Ã¶" = "ö",
                                        "Ã©" = "é", "Ãª" = "ê", "Ã¨" = "è",
                                        "Ã´" = "ô", "Ã§" = "ç")),
         party = party_abbreviation,
         q = 1)

chnom$decision <- recode(chnom$answer.code,
                         '0' = '0', '1' = '1', '2' = '3',
                         '3' = '11', '4' = '11', '5' = '11',
                         )
chnom %<>% select(vote, date, decision, name, party, canton, q)

chnom.9603 <- chnom
rm(nr_votes_ws1996_hs2003)
```

2.2 2003 - 2018

```
# Load data provided by https://www.gfzb.ch/
chnom <- readRDS("data/abstimmungen.rds")

chnom %<>% mutate(name = paste(c_name, c_vorname, sep = ' '),
                  date = ymd_hms(v_date),
                  q = 2)

cdet <- readRDS("data/personen2.rds")
chnom <- left_join(chnom,
                   dplyr::select(cdet, Name, Name2, party1, party2, party3,
                                 CantonAbbreviation),
                   by=c("name"="Name")) %>% filter(!is.na(v_id))
chnom$name <- chnom$Name2
chnom$Name2 <- NULL
chnom %<>% unique()

chnom$decision <- recode(chnom$v_c_decision,
                         "No" = '0', "Yes" = '1', "EH" = '3',
```

```
                          "P" = '12', "Invalid8" = '12', "NT" = '12', "ES" = '12'
                          )

chnom %<>%
  rename(canton = CantonAbbreviation,
         vote = v_id,
         party = party1) %>%
  select(vote, date, decision, name, party, canton, q)

chnom.0318 <- chnom
```

```
chnom <- rbind(chnom.9603, chnom.0318)

# Correct for party
chnom$party <- recode(chnom$party,
                      "BDP" = "BDP",
                      "CVP" = "CVP",
                      "FDP" = "FDP",
                      "FDP-Liberale" = "FDP",
                      "GB" = "GPS",
                      "GPS" = "GPS",
                      "glp" = "glp",
                      "SP" = "SP",
                      "SVP" = "SVP",
                      .default = "andere",
                      .missing = "andere")

# Corrections for multiple party affiliations, names
chnom$name[chnom$name == "Baumann Alexander"] <- "Baumann J. Alexander"
chnom$name[chnom$name == "Borer Roland"] <- "Borer Roland F."
chnom$name[chnom$name == "Bruderer Pascale"] <- "Bruderer Wyss Pascale"
chnom$name[chnom$name == "Fässler Hildegard"] <- "Fässler-Osterwalder Hildegard"
chnom$name[chnom$name == "Gadient Brigitta"] <- "Gadient Brigitta M."
chnom$name[chnom$name == "Haller Ursula"] <- "Haller Vannini Ursula"
chnom$name[chnom$name == "Imfeld Adrian"] <- "Imfeld Adriano"
chnom$name[chnom$name == "Simoneschi Chiara"] <- "Simoneschi-Cortesi Chiara"
chnom$name[chnom$name == "Suter Marc Frederic"] <- "Suter Marc F."
chnom$name[chnom$name == "Vermot Ruth-Gaby"] <- "Vermot-Mangold Ruth-Gaby"

chnom$party[chnom$name == "Haller Vannini Ursula"] <- "SVP"
chnom$party[chnom$name == "Borer Roland F."] <- "SVP"
```

```r
chnom$party[chnom$name == "Giezendanner Ulrich"] <- "SVP"
chnom$party[chnom$name == "Goll Christine"] <- "SP"
chnom$party[chnom$name == "Günter Paul"] <- "SP"
chnom$party[chnom$name == "Leutenegger Oberholzer Susanne"] <- "SP"
chnom$party[chnom$name == "Lüscher Christian"] <- "FDP"
chnom$party[chnom$name == "Miesch Christian"] <- "SVP"
chnom$party[chnom$name == "Stamm Luzi"] <- "SVP"
chnom$party[chnom$name == "von Felten Margrith"] <- "GPS"

chnom %<>% mutate(mp = paste0(name, " (", party, " ", canton, ")"))

chnom$session <- NA
chnom$session[chnom$date >= ymd("1996-01-01")] <- 1
chnom$session[chnom$date >= ymd("1997-12-01")] <- 2
chnom$session[chnom$date >= ymd("1999-12-01")] <- 3
chnom$session[chnom$date >= ymd("2001-11-26")] <- 4
chnom$session[chnom$date >= ymd("2003-12-01")] <- 5
chnom$session[chnom$date >= ymd("2005-11-28")] <- 6
chnom$session[chnom$date >= ymd("2007-12-03")] <- 7
chnom$session[chnom$date >= ymd("2009-11-23")] <- 8
chnom$session[chnom$date >= ymd("2011-12-05")] <- 9
chnom$session[chnom$date >= ymd("2013-11-25")] <- 10
chnom$session[chnom$date >= ymd("2015-11-29")] <- 11
chnom$session[chnom$date >= ymd("2017-11-26")] <- 12
chnom$session <- as.factor(chnom$session)

chnom$legis <- recode(chnom$session,
                      '1' = 45, '2' = 45,
                      '3' = 46, '4' = 46,
                      '5' = 47, '6' = 47,
                      '7' = 48, '8' = 48,
                      '9' = 49, '10' = 49,
                      '11' = 50, '12' = 50)

chnom %<>% distinct()

# save the recoded data frame
saveRDS(chnom, "data/chnom.rds")
rm(cdet)
```

3 DW-NOMINATE

The following process builds on Poole & Rosenthal (2000), "Congress: a political-economic history of roll call voting" (see also https://voteview.com). They presented an approach to calculate ideological positions by scaling/sorting members of parliament (MP) on a spatial map based on their voting behavior. Intended for the US congress, the same procedure can also be applied to the Swiss National Council.

The next step is to scale MPs through DW-NOMINATE (Dynamic Weighted Nominal Three-step Estimation). Note: while W-NOMINATE is available through the R-package `wnominate`, this procedure is only applicable to single legislatures. Thankfully, github-user `wmay` provides an R-Package called `dwnominate` which allows to apply the same procedure for multiple legislatures (https://github.com/wmay/dwnominate).

The next step is computationally intense. Please note that `dwnominate()` has a limit of 3'600 roll calls per legislature. The data will thus be split in 2-year periods instead of the full 4-year legislature.

3.1 Rollcall data, model

```
# Load dwnominate from github
pacman::p_load('devtools')
if (!require("dwnominate", quietly=T)) install_github("wmay/dwnominate")
library(dwnominate)

# prepare roll call data, split into 2-year-legislatures
#chnom <- readRDS("data/chnom.rds")
nomd <- list()
for (i in 1:12) {
  d <- chnom %>%
    filter(session == i) %>%
    select(vote, name, decision) %>%
    spread(key = vote, value = decision, sep = ".") %>%
    left_join(
      select(chnom, name, party, canton) %>% distinct(),
      by = "name"
    ) %>%
    select(name, party, canton,
           everything())
  nomd[[i]] <- d
}

rc <- list()
for (i in 1:12) {
  d <- as.matrix(nomd[[i]])
  rc.mps <- d[,1]
```

```
  rc.cov <- data.frame(d[,2:3])
  rc.votes <- d[,4:ncol(d)]
  rc.vote.names <- data.frame(d[,4:ncol(d)]) %>% colnames() %>% data.frame()

  rc[[i]] <- rollcall(data = rc.votes,
                      yea = c("1"), nay = c("0"),
                      missing = c("3", "11", "12"),
                      notInLegis = NA,
                      legis.names = rc.mps,
                      legis.data = rc.cov,
                      vote.data = rc.vote.names,
                      desc = "NR Abstimmungen 1996-2018",
                      source = "parlament.ch / GFZB / @claudermont")
}

# save roll call data
saveRDS(rc, "data/rc_sess.rds")
rm(nomd, i, rc.cov, rc.votes, rc.mps, d)
```

```
# One-Dimensional
results <- dwnominate(rc, dims=1)
saveRDS(results, "results/results_dwnom1d.rds")

# Two-Dimensional
results <- dwnominate(rc, dims=2)
saveRDS(results, "results/results_dwnom2d.rds")
```

3.2 Recode and save

```
results <- readRDS("results/results_dwnom1d.rds")

# extract ideological positions by legislator, merge with covariates, save
scores <- results$legislators
scores$tf <- recode_factor(scores$session,
                           '1' = '1996-97', '2' = '1998-99',
                           '3' = '2000-01', '4' = '2002-03',
                           '5' = '2003-05', '6' = '2005-07',
                           '7' = '2007-09', '8' = '2009-11',
                           '9' = '2011-13', '10' = '2013-15',
                           '11' = '2015-17', '12' = '2017-18')
```

```
scores$party[scores$name == "Hassler Hansjörg" |
               scores$name == "Gadient Brigitta M." |
               scores$name == "Grunder Hans" |
               scores$name == "Haller Vannini Ursula" &
               scores$session >= 8] <- "BDP"
scores$party[scores$name == "Bäumle Martin" & scores$session >= 6] <- "glp"
scores$party[scores$name == "Müller Thomas" & scores$session >= 9] <- "SVP"


scores$party[scores$name == "Goll Christine" & scores$session < 2] <- "andere"
scores$party[scores$name == "von Felten Margrith" & scores$session >= 2] <- "GPS"
scores$party[scores$name == "Borer Roland F." & scores$session <= 2] <- "andere"
scores$party[scores$name == "Giezendanner Ulrich" & scores$session < 2] <- "andere"
scores$party[scores$name == "Stamm Luzi" & scores$session < 4] <- "FDP"

scores.dwnom1d  <- scores
saveRDS(scores, "results/scores_dwnom1d.rds")
```

```
results <- readRDS("results/results_dwnom2d.rds")

# plot(results)

# extract ideological positions by legislator, merge with covariates, save
scores <- results$legislators
scores$tf <- recode_factor(scores$session,
                           '1' = '1996-97', '2' = '1998-99',
                           '3' = '2000-01', '4' = '2002-03',
                           '5' = '2003-05', '6' = '2005-07',
                           '7' = '2007-09', '8' = '2009-11',
                           '9' = '2011-13', '10' = '2013-15',
                           '11' = '2015-17', '12' = '2017-18')

scores$party[scores$name == "Hassler Hansjörg" |
               scores$name == "Gadient Brigitta M." |
               scores$name == "Grunder Hans" |
               scores$name == "Haller Vannini Ursula" &
               scores$session >= 8] <- "BDP"
scores$party[scores$name == "Bäumle Martin" & scores$session >= 6] <- "glp"
scores$party[scores$name == "Müller Thomas" & scores$session >= 9] <- "SVP"
```

```
scores$party[scores$name == "Goll Christine" & scores$session < 2] <- "andere"
scores$party[scores$name == "von Felten Margrith" & scores$session >= 2] <- "GPS"
scores$party[scores$name == "Borer Roland F." & scores$session <= 2] <- "andere"
scores$party[scores$name == "Giezendanner Ulrich" & scores$session < 2] <- "andere"
scores$party[scores$name == "Stamm Luzi" & scores$session < 4] <- "FDP"

scores.dwnom2d  <- scores
saveRDS(scores, "results/scores_dwnom2d.rds")
```

3.3 Plots

Having the results, the ideological scores can be used to plot politicians. First, a ridge-plot (package `ggridges`) for the dominating left-right dimension (`coord1D`), illustrating how the parties consolidated over the last 22 years in their voting behavior.

```
scores.dwnom1d <- readRDS("results/scores_dwnom1d.rds")

scores.dwnom1d$partylab <- recode_factor(scores.dwnom1d$party,
                        "SP" = "SP",
                        "GPS" = "GPS",
                        "CVP" = "CVP",
                        "FDP" = "FDP",
                        "SVP" = "SVP",
                        .default = NA_character_,
                        .missing = NA_character_,
                        .ordered = T)

scores.dwnom1d %>%
  filter(!is.na(partylab) & !is.na(tf)) %>%
  mutate(tf = fct_rev(as.factor(tf))) %>%
  ggplot(aes(y = tf, x = -coord1D)) +
  geom_density_ridges(aes(fill = partylab),
                      alpha = .7, scale=0.95,
                      panel_scaling=F) +
  scale_x_continuous(lim = c(-1.15,1.15), expand = c(0, 0)) +
  scale_y_discrete(expand = c(0, 0)) +
  scale_fill_manual(
    values = c(
      "SP" = "#252525",
      "GPS" = "#969696",
      "CVP" = "#525252",
```

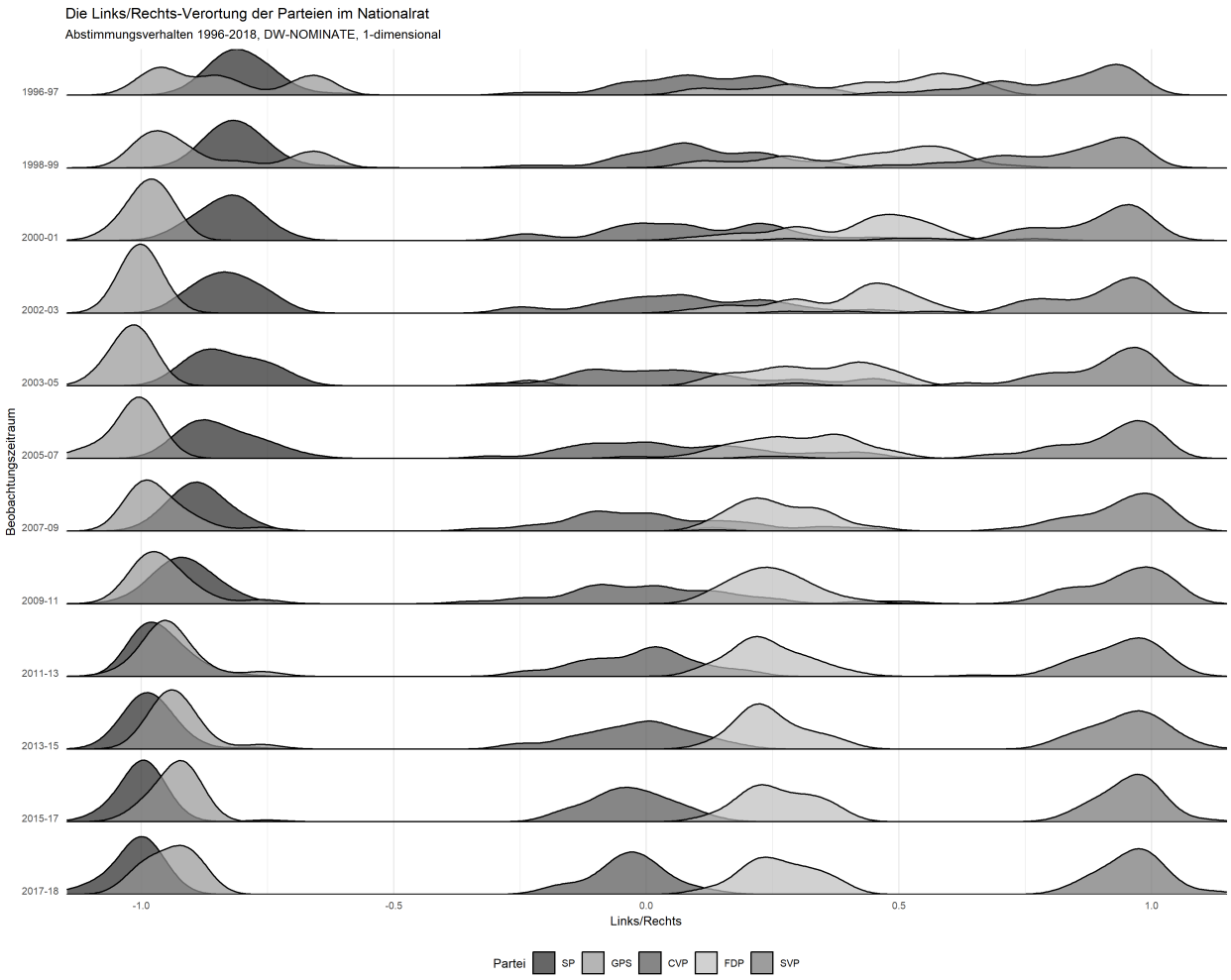

Figure 1: Ridgeplot left/right-axis, black/white for publication with reduced number of parties.

```
    "FDP" = "#bdbdbd",
    "SVP" = "#737373"
    )) +
labs(x = "Links/Rechts",
     y = "Beobachtungszeitraum",
     title = "Die Links/Rechts-Verortung der Parteien im Nationalrat",
     subtitle = "Abstimmungsverhalten 1996-2018, DW-NOMINATE, 1-dimensional",
     fill="Partei") +
theme_minimal() +
theme(text = element_text(size = 9),
      axis.text.y = element_text(vjust = 0),
      legend.position = "bottom")
```

```
ggsave("img/chnom_lrridge.png",
       width = 222, height = 344,
       units = "mm", dpi = 350)
ggsave("img/chnom_lrridge.eps",
       width = 222, height = 344,
       units = "mm", dpi = 350)
ggsave("img/chnom_lrridge.pdf",
       width = 222, height = 344,
       units = "mm", dpi = 350)
```

```
scores.dwnom1d %>%
  filter(party != "andere" & !is.na(tf)) %>%
  mutate(tf = fct_rev(as.factor(tf))) %>%
  ggplot(aes(y = tf, x = -coord1D)) +
    geom_density_ridges(aes(fill = paste(party)),
              alpha = .7, scale=0.95,
              panel_scaling=F) +
  scale_x_continuous(lim = c(-1.15,1.15), expand = c(0, 0)) +
  scale_y_discrete(expand = c(0, 0)) +
  scale_fill_manual(
    values = c(
      "BDP" = "gold",
      "CVP" = "orange",
      "FDP" = "darkblue",
      "glp" = "lawngreen",
      "SP" = "firebrick",
      "SVP" = "yellowgreen",
      "GPS" = "green"
    )) +
  labs(x = "Links/Rechts",
       y = "Beobachtungszeitraum",
       title = "Die Links/Rechts-Verortung der Parteien im Nationalrat",
       subtitle = "Abstimmungsverhalten 1996-2018, DW-NOMINATE, 1-dimensional",
       fill="Partei") +
  theme_minimal() +
  theme(axis.text.y = element_text(vjust = 0))
```

Second, two-dimensional maps similar to smartvote (https://smartvote.ch/).

```
scores.dwnom2d <- readRDS("results/scores_dwnom2d.rds")

# Smartmap
```

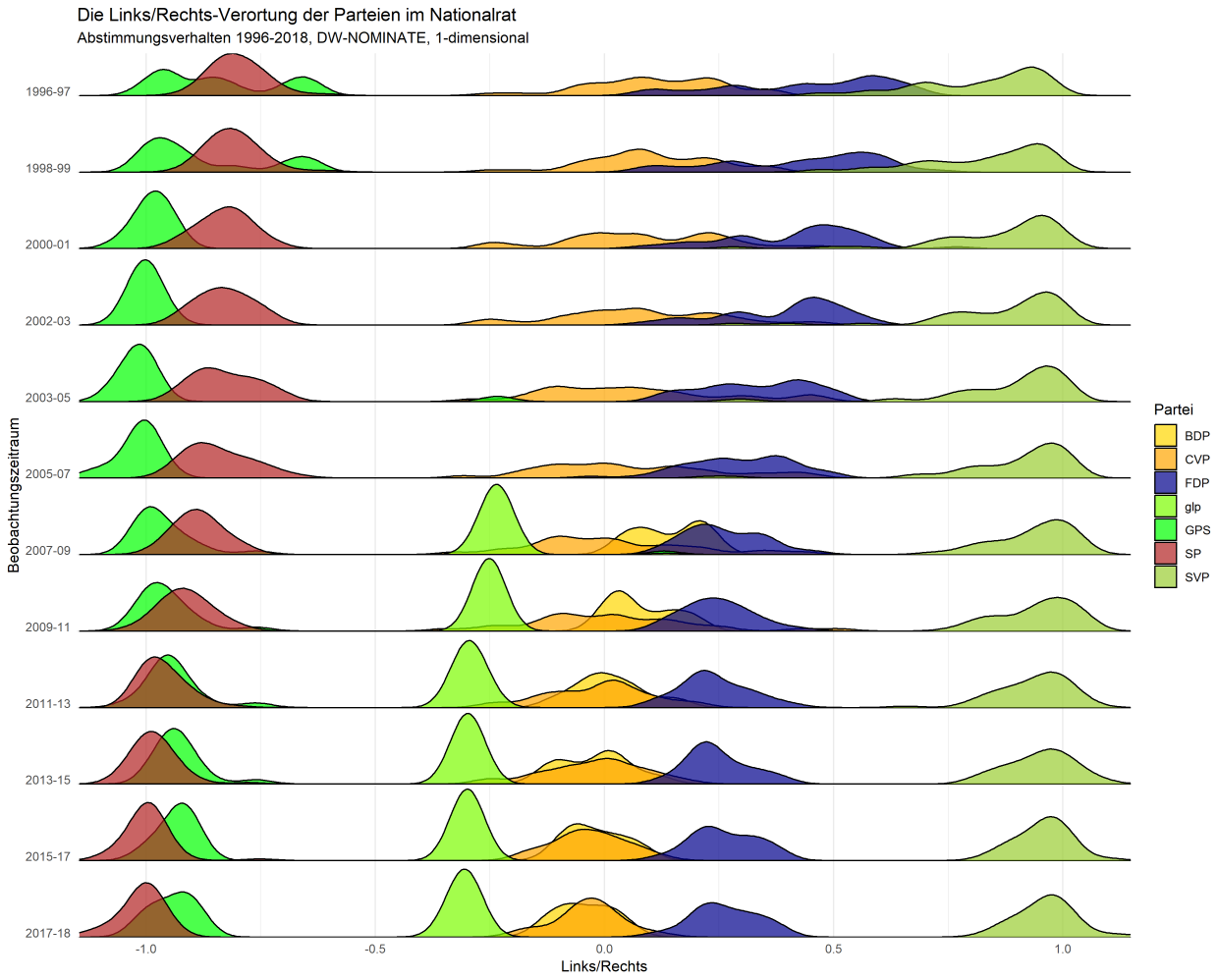

Figure 2: Ridgeplot left/right-axis, in color for documentation with full number of parties.

```
scores.dwnom2d %>%
  filter(!is.na(tf)) %>%
  ggplot() +
  geom_point(aes(x = -coord1D, y = -coord2D, color = party),
             alpha = 0.7) +
  facet_wrap(~tf, ncol = 4) +
  coord_fixed() +
  scale_x_continuous(lim = c(-1,1)) +
  scale_y_continuous(lim = c(-1,1)) +
  scale_shape_manual(values = c(3)) +
  scale_colour_manual(
    values = c(
      "BDP" = "gold",
      "CVP" = "orange",
      "FDP" = "darkblue",
      "glp" = "lawngreen",
      "SP" = "firebrick",
      "SVP" = "yellowgreen",
      "GPS" = "green",
      "andere" = "grey"
    )) +
  labs(x = "Links/Rechts",
       y = "2. Dimension",
       title = "Die ideologische Verortung der Parteien im Nationalrat",
       subtitle = "Abstimmungsverhalten 1996-2018, DW-NOMINATE, 2-dimensional",
       color = "Partei") +
  theme_minimal()
```

4 W-NOMINATE, separate models

In order to have a snapshot for each *4-year* legislature, W-NOMINATE models are estimated additionally to the DW-NOMINATE overall model.

4.1 Rollcall data, models

```
# prepare roll call data, split into 2-year-legislatures
chnom <- readRDS("data/chnom.rds")
nomd <- list()
for (i in 45:50) {
  d <- chnom %>%
```

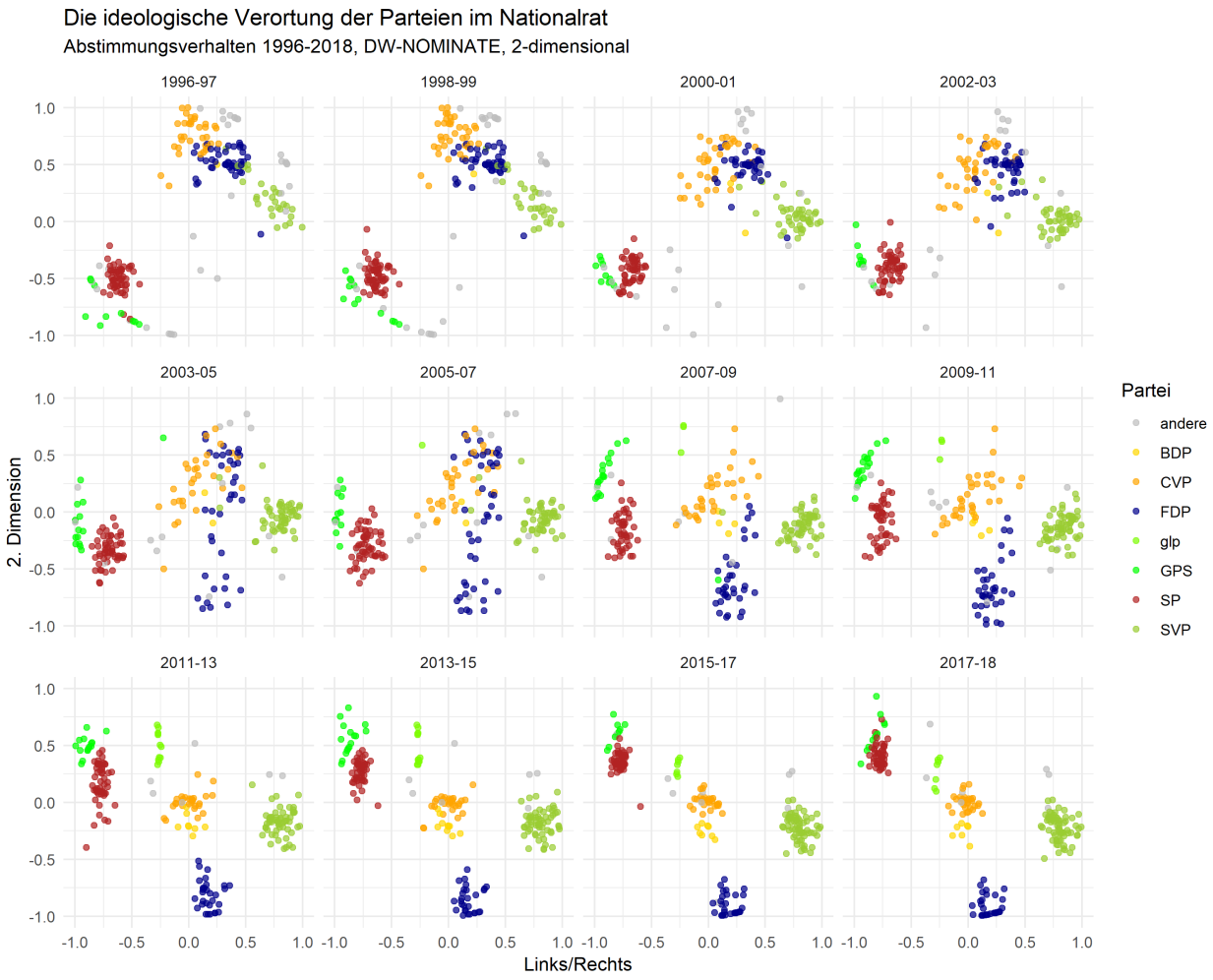

Figure 3: Scoremap, change over time.

```
    filter(legis == i) %>%
    select(vote, name, decision) %>%
    spread(key = vote, value = decision, sep = ".") %>%
    left_join(
      select(chnom, name, party, canton) %>% distinct(),
      by = "name"
    ) %>%
    select(name, party, canton,
           everything())
  nomd[[i-44]] <- d
}

rc <- list()
for (i in 1:6) {
  d <- as.matrix(nomd[[i]])
  rc.mps <- d[,1]
  rc.cov <- data.frame(d[,2:3])
  rc.votes <- d[,4:ncol(d)]
  rc.vote.names <- data.frame(d[,4:ncol(d)]) %>% colnames() %>% data.frame()

  rc[[i]] <- rollcall(data = rc.votes,
                      yea = c("1"), nay = c("0"),
                      missing = c("3", "11", "12"),
                      notInLegis = NA,
                      legis.names = rc.mps,
                      legis.data = rc.cov,
                      vote.data = rc.vote.names,
                      desc = "NR Abstimmungen 1996-2018",
                      source = "parlament.ch / GFZB / @claudermont")
}

# save roll call data
saveRDS(rc, "data/rc_legis.rds")
rm(nomd, i, rc.cov, rc.votes, rc.mps, d)
```

```
library(wnominate)
results.2d <- list()
for (i in 1:6) {
  rcx <- rc[[i]]

  results.2d[[i]] <- wnominate(rcx, dims=2, polarity = c(1,1))
```

```
}

saveRDS(results.2d, "results/results_wnom2d.rds")

results.3d <- list()
for (i in 1:6) {
  rcx <- rc[[i]]

  results.3d[[i]] <- wnominate(rcx, dims=3, polarity = c(1,1,1))
}

saveRDS(results.3d, "results/results_wnom3d.rds")

results.4d <- list()
for (i in 1:6) {
  rcx <- rc[[i]]

  results.4d[[i]] <- wnominate(rcx, dims=4, polarity = c(1,1,1,1))
}

saveRDS(results.4d, "results/results_wnom4d.rds")
```

4.2 Recode and save

```
scores.2d <- list()
results.2d[[1]]$legislators %>%
  mutate(name = row.names(.),
         coord1D = coord1D*(-1),
         coord2D = coord2D*(-1),
         legis = 45) -> scores.2d[[1]]
results.2d[[2]]$legislators %>%
  mutate(name = row.names(.),
         legis = 46) -> scores.2d[[2]]
results.2d[[3]]$legislators %>%
  mutate(name = row.names(.),
         legis = 47) -> scores.2d[[3]]
results.2d[[4]]$legislators %>%
  mutate(name = row.names(.),
         legis = 48) -> scores.2d[[4]]
results.2d[[5]]$legislators %>%
```

```
  mutate(name = row.names(.),
         coord2D = coord2D*(-1),
         legis = 49) -> scores.2d[[5]]
results.2d[[6]]$legislators %>%
  mutate(name = row.names(.),
         coord2D = coord2D*(-1),
         legis = 50) -> scores.2d[[6]]
scores <- rbind(scores.2d[[1]],
                scores.2d[[2]],
                scores.2d[[3]],
                scores.2d[[4]],
                scores.2d[[5]],
                scores.2d[[6]])

scores$tf <- recode_factor(scores$legis,
                           '45' = '1996-99', '46' = '1999-03',
                           '47' = '2003-07', '48' = '2007-11',
                           '49' = '2011-15', '50' = '2015-18')

scores$party[scores$name == "Hassler Hansjörg" |
               scores$name == "Gadient Brigitta M." |
               scores$name == "Grunder Hans" |
               scores$name == "Haller Vannini Ursula" &
               scores$legis >= 48] <- "BDP"
scores$party[scores$name == "Bäumle Martin" & scores$legis >= 48] <- "glp"
scores$party[scores$name == "Müller Thomas" & scores$legis >= 49] <- "SVP"

scores$party[scores$name == "Goll Christine" & scores$legis < 46] <- "andere"
scores$party[scores$name == "von Felten Margrith" & scores$legis >= 46] <- "GPS"
scores$party[scores$name == "Borer Roland F." & scores$legis <= 46] <- "andere"
scores$party[scores$name == "Giezendanner Ulrich" & scores$legis < 46] <- "andere"
scores$party[scores$name == "Stamm Luzi" & scores$legis < 47] <- "FDP"

scores.2d <- scores
saveRDS(scores, "results/scores_wnom2d.rds")
```

```
scores.3d <- list()
results.3d[[1]]$legislators %>%
  mutate(name = row.names(.),
         coord1D = coord1D*(-1),
         coord2D = coord2D*(-1),
```

```
         coord3D = coord3D*(-1),
         legis = 45) -> scores.3d[[1]]
results.3d[[2]]$legislators %>%
  mutate(name = row.names(.),
         legis = 46) -> scores.3d[[2]]
results.3d[[3]]$legislators %>%
  mutate(name = row.names(.),
         legis = 47) -> scores.3d[[3]]
results.3d[[4]]$legislators %>%
  mutate(name = row.names(.),
         legis = 48) -> scores.3d[[4]]
results.3d[[5]]$legislators %>%
  mutate(name = row.names(.),
         coord2D = coord2D*(-1),
         coord3D = coord3D*(-1),
         legis = 49) -> scores.3d[[5]]
results.3d[[6]]$legislators %>%
  mutate(name = row.names(.),
         coord2D = coord2D*(-1),
         coord3D = coord3D*(-1),
         legis = 50) -> scores.3d[[6]]
scores <- rbind(scores.3d[[1]],
                scores.3d[[2]],
                scores.3d[[3]],
                scores.3d[[4]],
                scores.3d[[5]],
                scores.3d[[6]])

scores$tf <- recode_factor(scores$legis,
                           '45' = '1996-99', '46' = '1999-03',
                           '47' = '2003-07', '48' = '2007-11',
                           '49' = '2011-15', '50' = '2015-18')

scores$party[scores$name == "Hassler Hansjörg" |
               scores$name == "Gadient Brigitta M." |
               scores$name == "Grunder Hans" |
               scores$name == "Haller Vannini Ursula" &
               scores$legis >= 48] <- "BDP"
scores$party[scores$name == "Bäumle Martin" & scores$legis >= 48] <- "glp"
scores$party[scores$name == "Müller Thomas" & scores$legis >= 49] <- "SVP"
```

```
scores$party[scores$name == "Goll Christine" & scores$legis < 46] <- "andere"
scores$party[scores$name == "von Felten Margrith" & scores$legis >= 46] <- "GPS"
scores$party[scores$name == "Borer Roland F." & scores$legis <= 46] <- "andere"
scores$party[scores$name == "Giezendanner Ulrich" & scores$legis < 46] <- "andere"
scores$party[scores$name == "Stamm Luzi" & scores$legis < 47] <- "FDP"

scores.3d <- scores
saveRDS(scores, "results/scores_wnom3d.rds")
```

```
scores.4d <- list()
results.4d[[1]]$legislators %>%
  mutate(name = row.names(.),
         coord1D = coord1D*(-1),
         coord2D = coord2D*(-1),
         coord3D = coord3D*(-1),
         coord4D = coord4D*(-1),
         legis = 45) -> scores.4d[[1]]
results.4d[[2]]$legislators %>%
  mutate(name = row.names(.),
         coord3D = coord3D*(-1),
         legis = 46) -> scores.4d[[2]]
results.4d[[3]]$legislators %>%
  mutate(name = row.names(.),
         legis = 47) -> scores.4d[[3]]
results.4d[[4]]$legislators %>%
  mutate(name = row.names(.),
         legis = 48) -> scores.4d[[4]]
results.4d[[5]]$legislators %>%
  mutate(name = row.names(.),
         coord2D = coord2D*(-1),
         coord3D = coord3D*(-1),
         legis = 49) -> scores.4d[[5]]
results.4d[[6]]$legislators %>%
  mutate(name = row.names(.),
         coord2D = coord2D*(-1),
         legis = 50) -> scores.4d[[6]]
scores <- rbind(scores.4d[[1]],
                scores.4d[[2]],
                scores.4d[[3]],
                scores.4d[[4]],
                scores.4d[[5]],
```

```
                scores.4d[[6]])

scores$tf <- recode_factor(scores$legis,
                           '45' = '1996-99', '46' = '1999-03',
                           '47' = '2003-07', '48' = '2007-11',
                           '49' = '2011-15', '50' = '2015-18')

scores$party[scores$name == "Hassler Hansjörg" |
               scores$name == "Gadient Brigitta M." |
               scores$name == "Grunder Hans" |
               scores$name == "Haller Vannini Ursula" &
               scores$legis >= 48] <- "BDP"
scores$party[scores$name == "Bäumle Martin" & scores$legis >= 48] <- "glp"
scores$party[scores$name == "Müller Thomas" & scores$legis >= 49] <- "SVP"

scores$party[scores$name == "Goll Christine" & scores$legis < 46] <- "andere"
scores$party[scores$name == "von Felten Margrith" & scores$legis >= 46] <- "GPS"
scores$party[scores$name == "Borer Roland F." & scores$legis <= 46] <- "andere"
scores$party[scores$name == "Giezendanner Ulrich" & scores$legis < 46] <- "andere"
scores$party[scores$name == "Stamm Luzi" & scores$legis < 47] <- "FDP"

scores.4d <- scores
saveRDS(scores, "results/scores_wnom4d.rds")
```

4.3 W-NOMINATE 2-Dimension: plots

```
scores.2d <- readRDS("results/scores_wnom2d.rds")

scores.2d %>%
  filter(party %in% c("SVP", "SP", "FDP", "CVP") & !is.na(tf)) %>%
  ggplot() +
  geom_point(aes(x = coord1D, y = coord2D, fill = tf, color = tf),
             shape = 21) +
  facet_wrap(~party, ncol = 2) +
  coord_fixed() +
  scale_x_continuous(lim = c(-1,1)) +
  scale_y_continuous(lim = c(-1,1)) +
  scale_shape_manual(values = c(3)) +
  scale_fill_brewer(palette = "Greys") +
  scale_color_manual(values =
```

```
                        c("1996-99" = "#969696",
                          "1999-03" = "#969696",
                          "2003-07" = "#969696",
                          "2007-11" = "#636363",
                          "2011-15" = "#252525",
                          "2015-18" = "#252525")) +
  labs(x = "Links/Rechts",
       y = "Konservativ/Progressiv",
       title = "Die ideologische Verortung der Parteien im Nationalrat",
       subtitle = "Abstimmungsverhalten 1996-2018, W-NOMINATE mit 2 Dimensionen",
       color = "Partei", fill = "Partei") +
  theme_minimal() +
  theme(text = element_text(size = 9))
```

```
ggsave("img/chnom_smartmap.png",
       width = 222, height = 222,
       units = "mm", dpi = 350)
ggsave("img/chnom_smartmap.eps",
       width = 222, height = 222,
       units = "mm", dpi = 350)
ggsave("img/chnom_smartmap.pdf",
       width = 222, height = 222,
       units = "mm", dpi = 350)
```

```
scores.2d <- readRDS("results/scores_wnom2d.rds")

scores.2d %>%
  filter(!is.na(tf)) %>%
  ggplot() +
  geom_point(aes(x = coord1D, y = coord2D, color = party),
             alpha = 0.7) +
  facet_wrap(~tf, ncol = 3) +
  coord_fixed() +
  scale_x_continuous(lim = c(-1,1)) +
  scale_y_continuous(lim = c(-1,1)) +
  scale_shape_manual(values = c(3)) +
  scale_colour_manual(
    values = c(
      "BDP" = "gold",
      "CVP" = "orange",
      "FDP" = "darkblue",
```

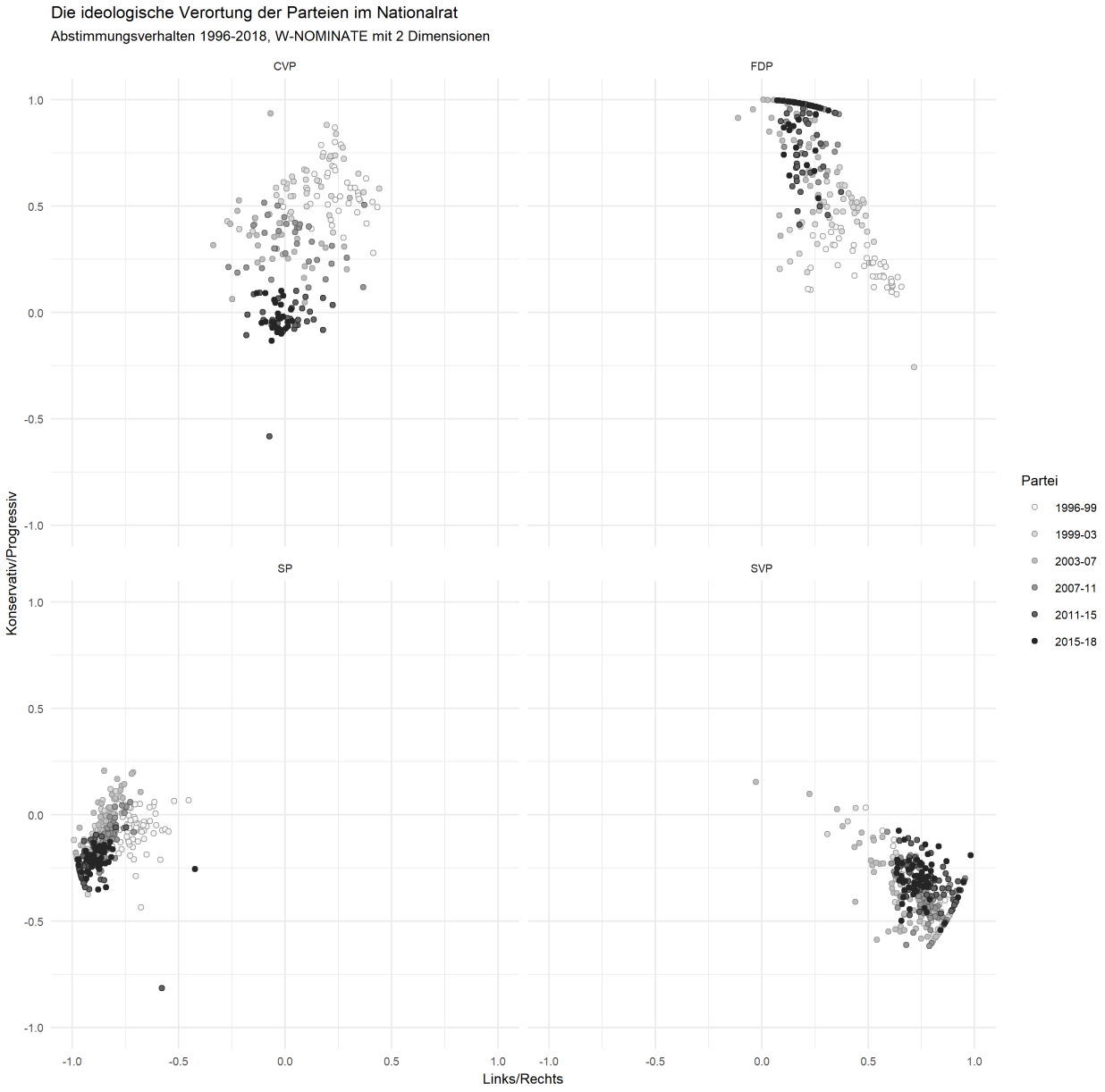

Figure 4: Scoremap W-NOMINATE with 2 dimensions by party and in b/w, change over time.

```
      "glp" = "lawngreen",
      "SP" = "firebrick",
      "SVP" = "yellowgreen",
      "GPS" = "green",
      "andere" = "grey"
    )) +
  labs(x = "Links/Rechts",
       y = "Konservativ/Progressiv",
       title = "Die ideologische Verortung der Parteien im Nationalrat",
       subtitle = "Abstimmungsverhalten 1996-2018, W-NOMINATE mit 2 Dimensionen",
       color = "Partei") +
  theme_minimal()
```

A plot highlighting the first and last legislature in the data.

```
labs <- bind_rows(
  list(lab = "SP",  tf = "1996-99", x = -.7,  y =  .18),
  list(lab = "GPS", tf = "1996-99", x = -.82, y = -.84),
  list(lab = "CVP", tf = "1996-99", x = -.06, y =  .8),
  list(lab = "FDP", tf = "1996-99", x =  .79, y =  .27),
  list(lab = "SVP", tf = "1996-99", x =  .86, y = -.1),
  list(lab = "SP",  tf = "2015-18", x = -.8,  y = -.04),
  list(lab = "GPS", tf = "2015-18", x = -.8,  y = -.68),
  list(lab = "CVP", tf = "2015-18", x =  .15, y =  .1),
  list(lab = "FDP", tf = "2015-18", x =  .45, y =  .9),
  list(lab = "SVP", tf = "2015-18", x =  .9,  y = -.08),
  list(lab = "GLP", tf = "2015-18", x = -.41, y =  .86),
  list(lab = "BDP", tf = "2015-18", x = -.31, y =  .4)
)

scores.2d %>%
  filter(!is.na(tf)) %>%
  mutate(partyother =
           ifelse(party %in% c("SVP","SP","FDP","CVP","GPS","BDP","glp"),
                  1, 0)) %>%
  filter(legis == 45 | legis == 50) %>%
  ggplot() +
  geom_point(aes(x = coord1D, y = coord2D, color = partyother),
             size = 0.75) +
  stat_ellipse(data = . %>% filter(party != "andere"),
               aes(x = coord1D, y = coord2D, group = party)) +
  geom_text(data = labs,
```

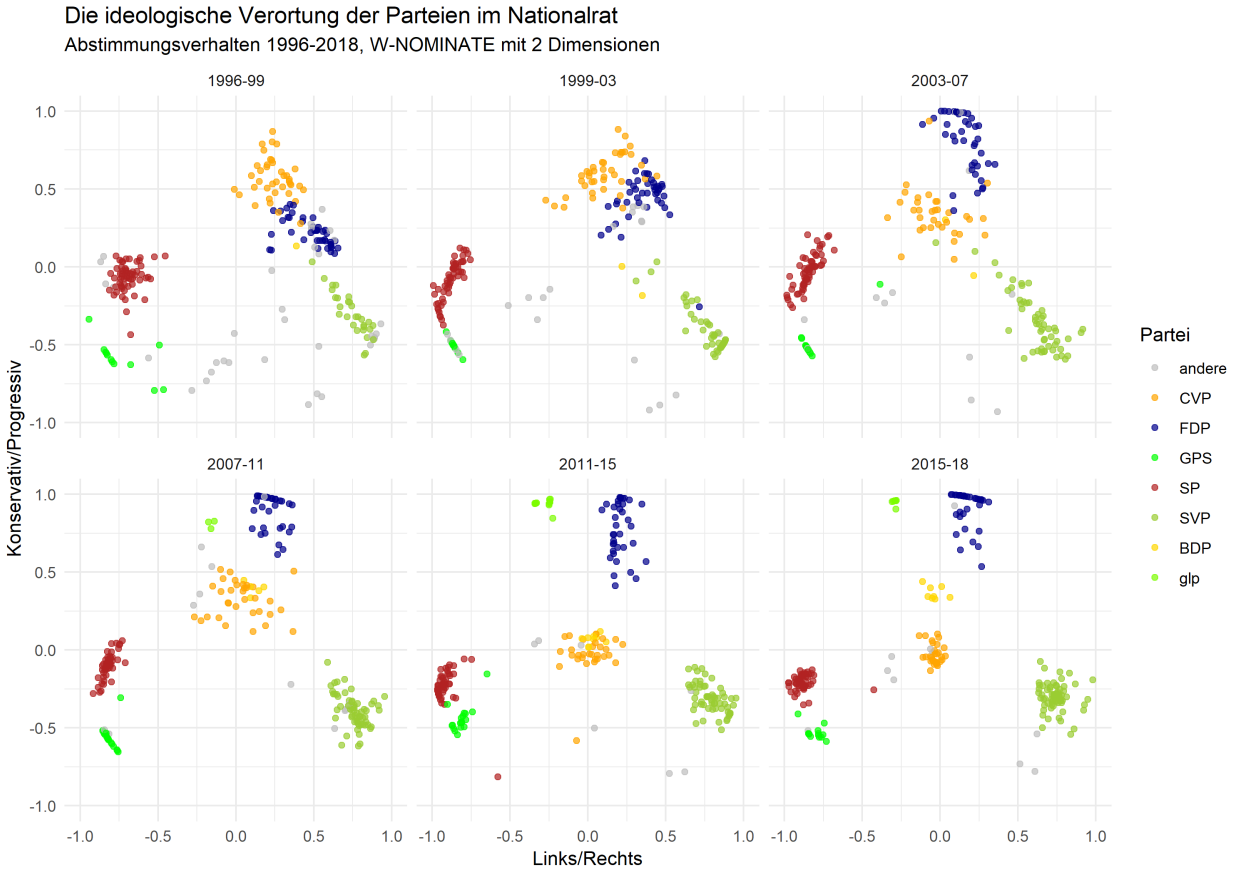

Figure 5: Scoremap W-NOMINATE with 2 dimensions by legislature and in color, change over time.

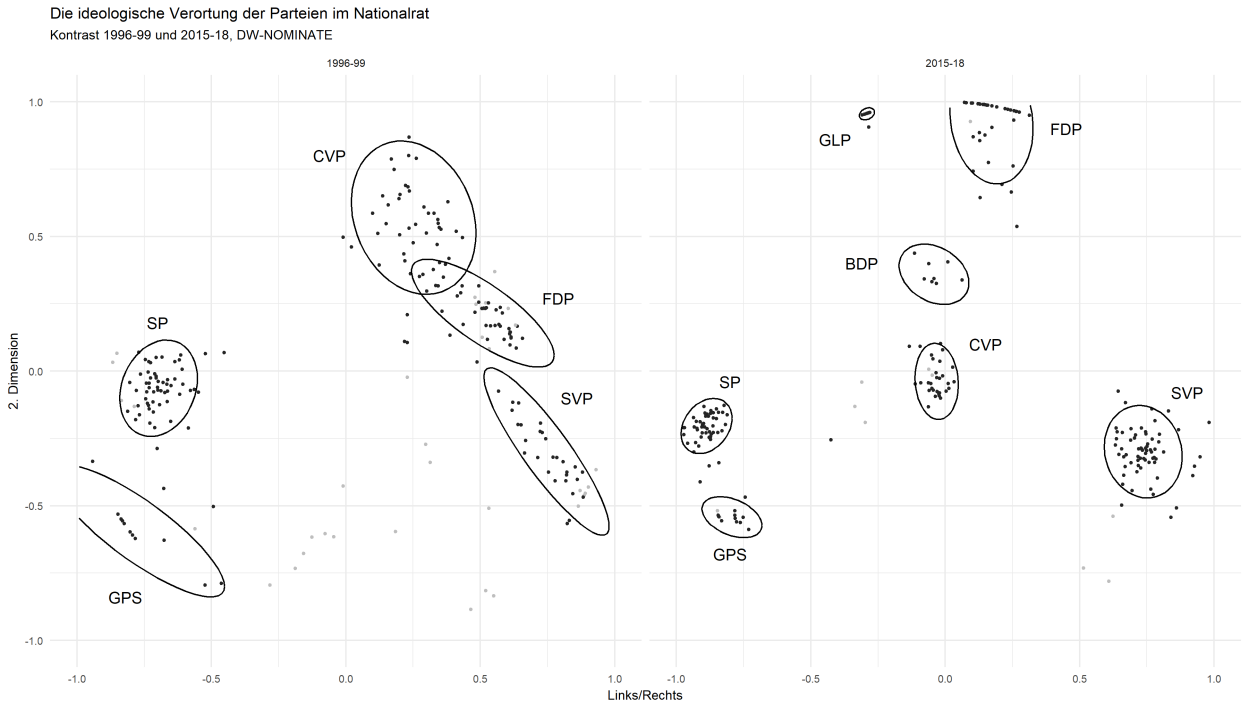

Figure 6: Scoremap in b/w, comparison begining/end.

```
          aes(label = lab, x = x, y = y)) +
facet_wrap(~tf) +
coord_fixed() +
scale_x_continuous(lim = c(-1,1)) +
scale_y_continuous(lim = c(-1,1)) +
scale_shape_manual(values = c(3)) +
scale_color_gradient(high = "#252525", low = "969696") +
labs(x = "Links/Rechts",
     y = "2. Dimension",
     title = "Die ideologische Verortung der Parteien im Nationalrat",
     subtitle = "Kontrast 1996-99 und 2015-18, DW-NOMINATE",
     color = "Partei") +
theme_minimal() +
theme(legend.position = "none",
      text = element_text(size = 9))
```

```
ggsave("img/chnom_smartmap_c.png",
       width = 222, height = 130,
       units = "mm", dpi = 350)
ggsave("img/chnom_smartmap_c.eps",
       width = 222, height = 130,
       units = "mm", dpi = 350)
ggsave("img/chnom_smartmap_c.pdf",
       width = 222, height = 130,
       units = "mm", dpi = 350)
```

```
scores.2d %>%
  filter(!is.na(tf)) %>%
  filter(legis == 45 | legis == 50) %>%
  ggplot() +
  geom_point(data = . %>% select(-tf) %>% filter(legis == 45),
             aes(x = coord1D, y = coord2D),
             color = "grey50", alpha = 0.2) +
  geom_point(aes(x = coord1D, y = coord2D, color = party),
             alpha = 0.7, size = 2) +
  stat_ellipse(data = . %>% filter(party != "andere"),
               aes(x = coord1D, y = coord2D, color = party)) +
  facet_wrap(~tf) +
  coord_fixed() +
  scale_x_continuous(lim = c(-1,1)) +
  scale_y_continuous(lim = c(-1,1)) +
  scale_shape_manual(values = c(3)) +
  scale_colour_manual(
    values = c(
      "BDP" = "gold",
      "CVP" = "orange",
      "FDP" = "darkblue",
      "glp" = "lawngreen",
      "SP" = "firebrick",
      "SVP" = "yellowgreen",
      "GPS" = "green",
      "andere" = "maroon3"
      )) +
  labs(x = "Links/Rechts",
       y = "2. Dimension",
       title = "Die ideologische Verortung der Parteien im Nationalrat",
       subtitle = "Kontrast 1996-99 und 2015-18, DW-NOMINATE",
```

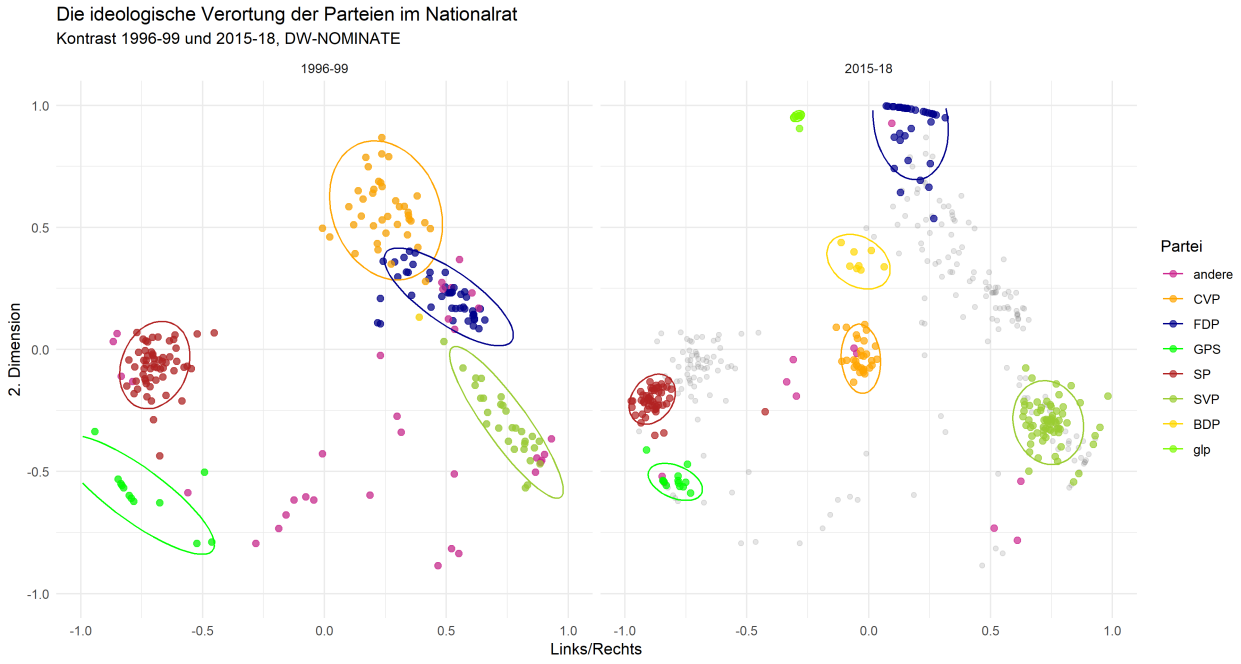

Figure 7: Scoremap in color, comparison begining/end.

```
      color = "Partei") +
  theme_minimal()
```

4.4 W-NOMINATE, more than 2 dimensions

The models show that for most legislatures, at least three dimensions are extractable (Eigenvalues > 1), and for two legislatures (2003-07 and 2015-18) even four dimensions. However, the results show that the additional third and fourth dimension pick up considerable less differences between parties than the first, dominant one (Eigenvalues 23.0-26.6), and somewhat lower than the second one referring to the traditional conservative/progressive dimension (Eigenvalues 1.8-2.3). The plots thus show only the first two dimensions. However, extracting more dimensions allows to have the first and second dimension more "pure", i.e., unbiased by further dimensions which differentiate voting behavior but explain a smaller fraction of variance in voting behavior.

```
scores.3d <- readRDS("results/scores_wnom3d.rds")

scores.3d %>%
  filter(!is.na(tf)) %>%
  ggplot() +
```

```
  geom_point(aes(x = coord1D, y = coord2D, color = party),
             alpha = 0.7) +
  facet_wrap(~tf, ncol = 3) +
  coord_fixed() +
  scale_x_continuous(lim = c(-1,1)) +
  scale_y_continuous(lim = c(-1,1)) +
  scale_shape_manual(values = c(3)) +
  scale_colour_manual(
    values = c(
      "BDP" = "gold",
      "CVP" = "orange",
      "FDP" = "darkblue",
      "glp" = "lawngreen",
      "SP" = "firebrick",
      "SVP" = "yellowgreen",
      "GPS" = "green",
      "andere" = "grey"
    )) +
  labs(x = "Links/Rechts",
       y = "Konservativ/Progressiv",
       title = "Die ideologische Verortung der Parteien im Nationalrat",
       subtitle = "Abstimmungsverhalten 1996-2018, W-NOMINATE mit 3 Dimensionen",
       color = "Partei") +
  theme_minimal()
```

```
scores.4d <- readRDS("results/scores_wnom4d.rds")

scores.4d %>%
  filter(!is.na(tf)) %>%
  ggplot() +
  geom_point(aes(x = coord1D, y = coord2D, color = party),
             alpha = 0.7) +
  facet_wrap(~tf, ncol = 3) +
  coord_fixed() +
  scale_x_continuous(lim = c(-1,1)) +
  scale_y_continuous(lim = c(-1,1)) +
  scale_shape_manual(values = c(3)) +
  scale_colour_manual(
    values = c(
      "BDP" = "gold",
      "CVP" = "orange",
```

Figure 8: Scoremap W-NOMINATE with 3 dimensions (first two plotted), change over time.

```
      "FDP" = "darkblue",
      "glp" = "lawngreen",
      "SP" = "firebrick",
      "SVP" = "yellowgreen",
      "GPS" = "green",
      "andere" = "grey"
    )) +
  labs(x = "Links/Rechts",
       y = "Konservativ/Progressiv",
       title = "Die ideologische Verortung der Parteien im Nationalrat",
       subtitle = "Abstimmungsverhalten 1996-2018, W-NOMINATE mit 4 Dimensionen",
       color = "Partei") +
  theme_minimal()
```

5 Overview figure

```
scores.2d <- readRDS("results/scores_wnom2d.rds")

cnflct <- bind_rows(
  list(cnflct = "Wertkonservativ vs. Gesell. Wandel",
       x1 =  0.75, y1 = -0.33, x2 =  0.2,  y2 =  0.9),
  list(cnflct = "Wertkonservativ vs. Gesell. Wandel",
       x1 = -0.9,  y1 = -0.2,  x2 =  0.75, y2 = -0.33),
  list(cnflct = "Veränderung vs. Status Quo",
       x1 =  0.2,  y1 =  0.9,  x2 = -0.9,  y2 = -0.2),
  list(cnflct = "Veränderung vs. Status Quo",
       x1 =  0.75, y1 = -0.33, x2 =  0.2,  y2 =  0.9),
  list(cnflct = "Links vs. Rechts",
       x1 = -0.9,  y1 = -0.2,  x2 =  0.75, y2 = -0.33)
)

cnflctlab <- bind_rows(
  list(lab = "Wertkonservativ", cnflct = "Wertkonservativ vs. Gesell. Wandel",
       x =  0.65, y = -0.6),
  list(lab = "Gesell. Wandel", cnflct = "Wertkonservativ vs. Gesell. Wandel",
       x =  -0.5, y = 0.5),
  list(lab = "Veränderung", cnflct = "Veränderung vs. Status Quo",
       x =  0.67, y = 0.9),
  list(lab = "Status Quo", cnflct = "Veränderung vs. Status Quo",
       x =  0.0, y = -0.3),
```

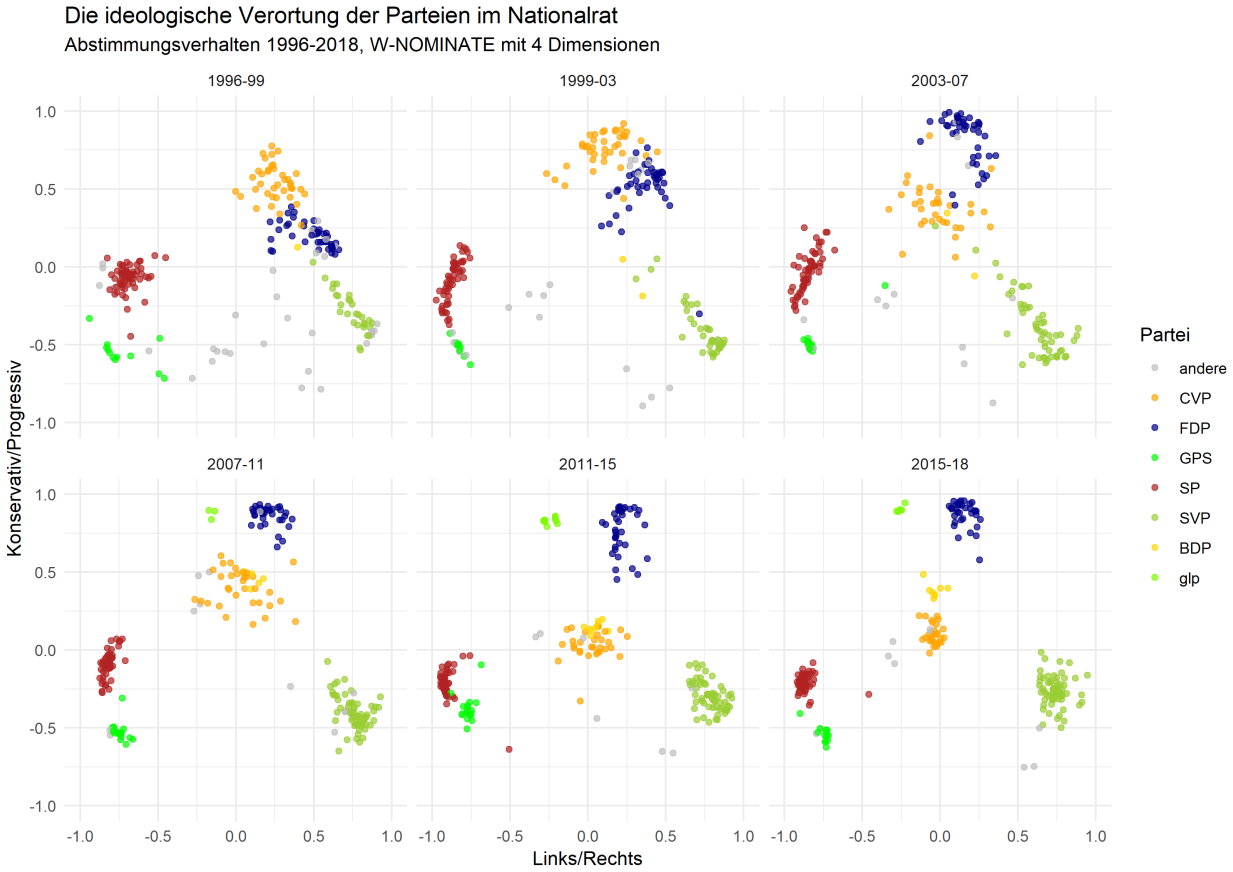

Figure 9: Scoremap W-NOMINATE with 4 dimensions (first two plotted), change over time.

```
  list(lab = "Links", cnflct = "Links vs. Rechts",
       x =  -0.8, y = 0.2),
  list(lab = "Rechts", cnflct = "Links vs. Rechts",
       x =  0.75, y = 0.2)
)

ggplot() +
  geom_point(data = scores.2d %>% filter(legis == 50),
             aes(x = coord1D, y = coord2D),
             color = "grey70", size = 0.8) +
  stat_ellipse(data = scores.2d %>% filter(legis == 50 & party != "andere"),
               aes(x = coord1D, y = coord2D, group = party), color = "grey20") +
  geom_curve(data = cnflct %>% filter(cnflct == "Wertkonservativ vs. Gesell. Wandel"),
             aes(x = x1, xend = x2, y = y1, yend = y2), curvature = -0.2,
             size = 1.5) +
  geom_curve(data = cnflct %>% filter(cnflct == "Veränderung vs. Status Quo"),
             aes(x = x1, xend = x2, y = y1, yend = y2), curvature = -0.15,
             size = 1.5) +
  geom_curve(data = cnflct %>% filter(cnflct == "Links vs. Rechts"),
             aes(x = x1, xend = x2, y = y1, yend = y2), curvature = -0.7,
             size = 1.5) +
  geom_text(data = cnflctlab,
            aes(x = x, y = y, label = lab), size = 2.5) +
  facet_wrap(~cnflct) +
  coord_fixed() +
  scale_x_continuous(lim = c(-1,1)) +
  scale_y_continuous(lim = c(-1,1)) +
  scale_shape_manual(values = c(3)) +
  labs(x = "Links/Rechts",
       y = "2. Dimension",
       title = "Ein tripolares System im Nationalrat?",
       subtitle = "W-NOMINATE mit 2 Dimensionen, 2015-18.") +
  theme_minimal() +
  theme(text = element_text(size = 9))
```

```
ggsave("img/chnom_smartmap_cnflct.png",
       width = 222, height = 90,
       units = "mm", dpi = 350)
ggsave("img/chnom_smartmap_cnflct.eps",
       width = 222, height = 90,
       units = "mm", dpi = 350)
```

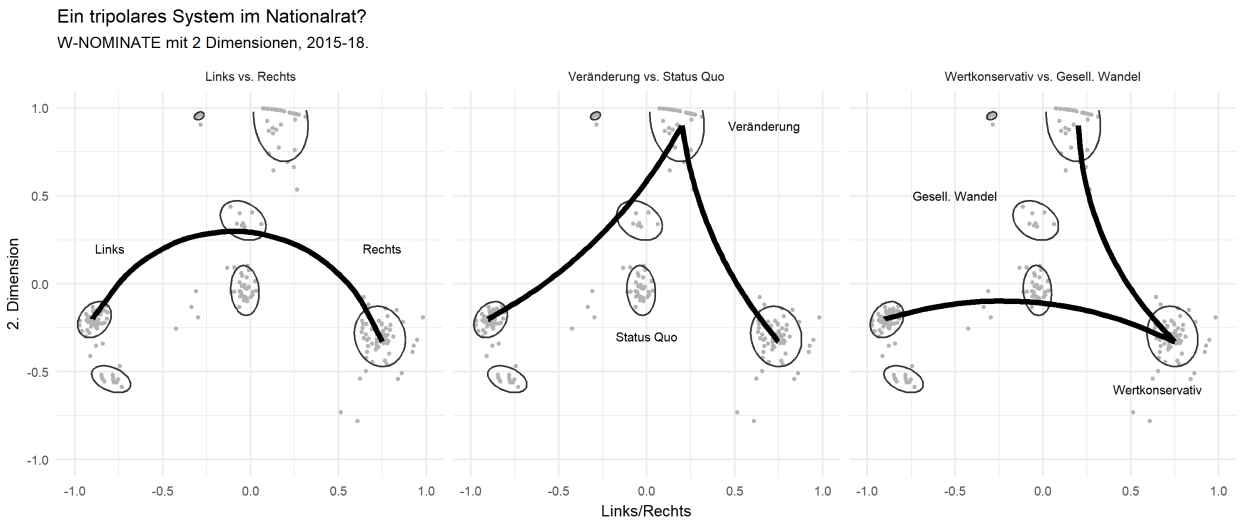

Figure 10: The three poles and its conflicts, b/w version.

```
ggsave("img/chnom_smartmap_cnflct.pdf",
       width = 222, height = 90,
       units = "mm", dpi = 350)
```

```
ggplot() +
  geom_point(data = scores.2d %>% filter(legis == 50),
             aes(x = coord1D, y = coord2D, color = party),
             alpha = 0.2, size = 2) +
  stat_ellipse(data = scores.2d %>% filter(legis == 50 & party != "andere"),
               aes(x = coord1D, y = coord2D, color = party)) +
  geom_curve(data = cnflct %>% filter(cnflct == "Wertkonservativ vs. Gesell. Wandel"),
             aes(x = x1, xend = x2, y = y1, yend = y2), curvature = -0.2,
             size = 1.5, alpha = 0.6) +
  geom_curve(data = cnflct %>% filter(cnflct == "Veränderung vs. Status Quo"),
             aes(x = x1, xend = x2, y = y1, yend = y2), curvature = -0.15,
             size = 1.5, alpha = 0.6) +
  geom_curve(data = cnflct %>% filter(cnflct == "Links vs. Rechts"),
             aes(x = x1, xend = x2, y = y1, yend = y2), curvature = -0.7,
             size = 1.5, alpha = 0.6) +
  geom_text(data = cnflctlab,
            aes(x = x, y = y, label = lab)) +
  facet_wrap(~cnflct) +
  coord_fixed() +
  scale_x_continuous(lim = c(-1,1)) +
  scale_y_continuous(lim = c(-1,1)) +
  scale_shape_manual(values = c(3)) +
  scale_colour_manual(
    values = c(
      "BDP" = "gold",
      "CVP" = "orange",
      "FDP" = "darkblue",
      "glp" = "lawngreen",
      "SP" = "firebrick",
      "SVP" = "yellowgreen",
      "GPS" = "green",
      "andere" = "maroon3"
      )) +
  labs(x = "Links/Rechts",
       y = "2. Dimension",
       title = "Ein tripolares System im Nationalrat?",
       subtitle = "W-NOMINATE mit 2 Dimensionen.",
```

```
       color = "Partei") +
  theme_minimal()
```

6 Session Info

```
sessionInfo()
```

```
## R version 3.5.2 (2018-12-20)
## Platform: x86_64-w64-mingw32/x64 (64-bit)
## Running under: Windows 10 x64 (build 17763)
##
## Matrix products: default
##
## locale:
## [1] LC_COLLATE=German_Switzerland.1252  LC_CTYPE=German_Switzerland.1252
## [3] LC_MONETARY=German_Switzerland.1252 LC_NUMERIC=C
## [5] LC_TIME=German_Switzerland.1252
##
## attached base packages:
## [1] stats     graphics  grDevices utils     datasets  methods   base
##
## other attached packages:
##  [1] bindrcpp_0.2.2  ggrepel_0.8.0   ggridges_0.5.1  wnominate_1.2.5
##  [5] pscl_1.5.2      broom_0.5.1     lubridate_1.7.4 magrittr_1.5
##  [9] forcats_0.3.0   stringr_1.3.1   dplyr_0.7.8     purrr_0.2.5
## [13] readr_1.3.1     tidyr_0.8.2     tibble_2.0.1    ggplot2_3.1.0
## [17] tidyverse_1.2.1 pacman_0.5.0
##
## loaded via a namespace (and not attached):
##  [1] tidyselect_0.2.5   xfun_0.4           haven_2.0.0
##  [4] lattice_0.20-38    colorspace_1.3-2   generics_0.0.2
##  [7] htmltools_0.3.6    yaml_2.2.0         rlang_0.3.1
## [10] pillar_1.3.1       glue_1.3.0         withr_2.1.2
## [13] RColorBrewer_1.1-2 modelr_0.1.2       readxl_1.2.0
## [16] bindr_0.1.1        plyr_1.8.4         munsell_0.5.0
## [19] gtable_0.2.0       cellranger_1.1.0   rvest_0.3.2
## [22] evaluate_0.12      labeling_0.3       knitr_1.21
## [25] Rcpp_1.0.0         scales_1.0.0       backports_1.1.3
## [28] jsonlite_1.6       hms_0.4.2          digest_0.6.18
## [31] stringi_1.2.4      bookdown_0.9       grid_3.5.2
```

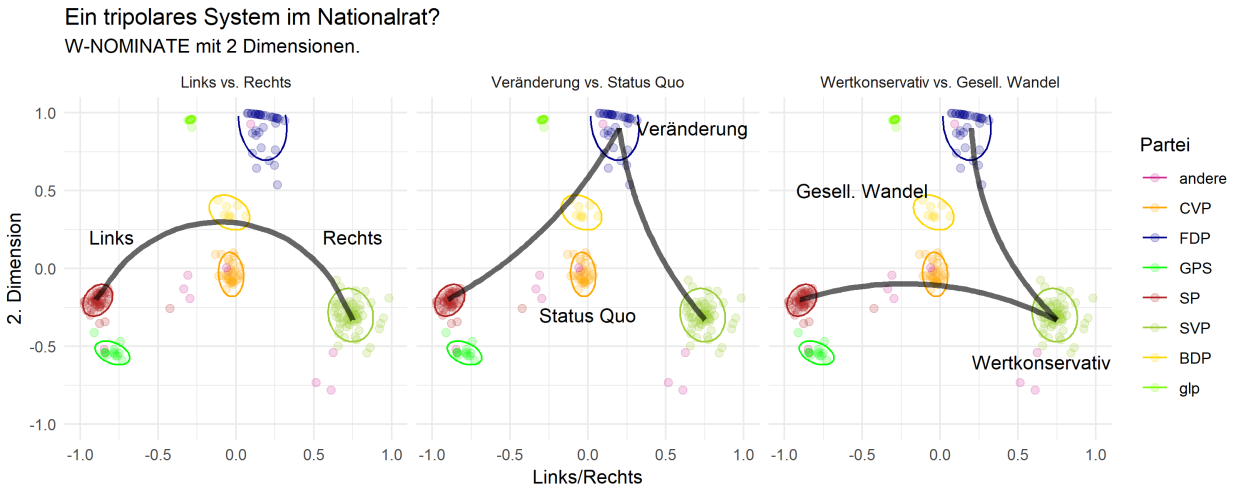

Figure 11: The three poles and its conflicts, color.

```
## [34] cli_1.0.1          tools_3.5.2        lazyeval_0.2.1
## [37] crayon_1.3.4       pkgconfig_2.0.2    MASS_7.3-51.1
## [40] xml2_1.2.0         assertthat_0.2.0   rmarkdown_1.11
## [43] httr_1.4.0         rstudioapi_0.9.0   R6_2.3.0
## [46] nlme_3.1-137       compiler_3.5.2
```